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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/709,733	05/25/2004	Emily E. Gallagher	BUR920030178US1	3732

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EXAMINER

ROSASCO, STEPHEN D

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 05/09/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/709,733

Applicant(s)

GALLAGHER ET AL.

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 28 February 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-48 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-48 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

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### Detailed Action

In response to the communication of 2/28/06, wherein a Declaration Under 37C.F.R. 1.131 was filed to swear behind two of the applied references, the previous office action rejections are withdrawn and new rejections are included here with newly cited art.

Claims 1-7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The preamble of the claim is to an EUV mask, whereas the mask comprises ultraviolet scattering and reflecting regions. The claims also recite the use of ultraviolet radiation. It is unclear how UV regions can function to make an EUV mask.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1 and 4-7 are rejected under 35 U.S.C. 102(b) as being anticipated by Stivers et al. (6,410,193).

Stivers et al. teach an EUV reflective lithography mask comprising a the use of multilayer reflectors of Mo and Si.

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Stivers et al. also teach (see and col. 6, lines 12-20) Along with using materials such as Ti, TiN, NiSi, Cr or Zr that intrinsically absorb but do not substantially reflect light within the DUV spectrum, additional processing steps may be undertaken to even further improve (i.e., reduce) their reflectivity within the DUV spectrum. For example, the surface of the absorber layer 204 may be roughened in order to "scatter" reflected DUV light (from the absorber layer 204) away from the collection lens of the inspection tool.

Claims 1, 4-7 are rejected under 35 U.S.C. 102(e) as being anticipated by Eurlings et al. (6,927,004).

Eurlings et al. teach (see claims) a reflective mask for use in a lithographic apparatus, the mask having areas of relatively high reflectance and areas of relatively low reflectance defining a mask pattern having a smallest printing feature size, wherein the areas of low reflectance comprise a layer having a texture at a scale smaller than the smallest printing feature size such that specular reflection from the areas of low reflectance is reduced.

And wherein the layer is formed from at least one of tantalum (Ta) and tantalum-nitride (TaN).

And wherein the texture has an rms roughness of greater than or equal to 1 nm.

Eurlings et al. also teach (col. 5, lines 48-54) that the terms "radiation" and "beam" are used to encompass all types of electromagnetic radiation, including ultraviolet radiation (e.g. with a wavelength of 365, 248, 193, 157 or 126 nm) and EUV (extreme ultra-violet radiation, e.g. having a wavelength in the range 5-20 nm), as well as particle beams, such as ion beams or electron beams.

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Claims 4-7 address that the radiation from the scattering regions or in the cited art above the roughened regions would be outside the collection angle of the exposure optics and that the shape of the regions would be jagged or curved. This would be an inevitable result of the use of a roughened surfaces.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stivers et al. (6,410,193) or Eurlings et al. (6,927,004) in view of Cardinale (6,368,942) and Kirchauer et al. (6,479,195).

The claimed invention is directed to a reflection or EUV mask and methods of making. The applicant discusses the limitations of the prior art in that conventional optical masks include transmissive and absorptive regions. However, because the masks used in the EUVL system are reflective, the EUV radiation must be exposed to the mask surface at an angle such that the pattern will reflect onto the surface of the wafer. Specifically, light incident on the exposed reflective surface is reflected. Light incident on the patterned absorber film is absorbed which heats the mask.

Five degrees is the optimal angle of exposure. The absorber stack height is finite and creates a shadow under the angle of illumination which blurs the edge of the raised absorber when imaged. This reduction in contrast is a function of the angle of the incident

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exposure light and both the absorber and buffer layer thickness. Reduced contrast at the pattern edges is a significant issue.

The claimed invention eliminates both buffer and absorber layers for a light scattering stack.

Stivers et al. and Eurlings et al. are included here as discussed above.

The teachings of Stivers et al. or Eurlings et al. differ from those of the applicant in that the applicant teaches (claims 8-48) the use of a crystalline silicon layer adjacent to the substrate, anodic bonding (claim 28) to bond the crystalline silicon layer to the substrate and the use of differently shaped scattering regions.

Cardinale teach a method for fabricating mask blanks for use in extreme ultraviolet lithography, comprising;

providing a wafer of an ultra-low expansion material;

providing a wafer of crystalline silicon;

bonding the wafer of crystalline silicon to the wafer of ultra-low expansion material;

reducing the thickness of the exposed surface of the wafer of crystalline silicon to a thickness of between about 5  $\mu\text{m}$  and 10  $\mu\text{m}$ ;

polishing the exposed surface of the reduced thickness crystalline silicon wafer thereby forming a mask blank of ultra-low expansion material with a crystalline silicon surface; and

forming a silicon oxide film on the crystalline silicon exposed surface for reducing thermal stress.

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And wherein the step of bonding is carried out by a technique selected from the group of bonding techniques consisting of anodic bonding, thermal compression bonding, and room temperature bonding.

Cardinale also teaches bonding a wafer of crystalline silicon to a surface of a wafer of an ULE material by a technique selected from the group of techniques consisting of anodic bonding, thermal compression bonding and room temperature bonding;

thinning an exposed surface of the wafer of crystalline silicon to a thickness of between about 5  $\mu\text{m}$  to about 10  $\mu\text{m}$ ; and

forming a silicon oxide film on the crystalline silicon exposed surface for reducing thermal stress.

Kirchauer et al. teach an EUV mask for photolithography comprising: a substrate; a multilayer disposed on said substrate, said multilayer being reflective, said multilayer having a first region and a second region; and an absorber layer disposed on said second region of said multilayer, said absorber layer having an upper surface that is rough.

Kirchauer et al. also teach (col. 5, lines 1-7) the use and benefits of ULE glass for the substrate, and the use of shapes to reflect light away from a desired direction (see Fig. 7).

It would have been obvious to one having ordinary skill in the art to take the teachings of Stivers et al. or Eurlings et al. and combine them with the teachings of Cardinale and Kirchauer et al. in order to make the claimed invention because using different shaped surfaces to scatter light in general is well known and the applicant is using processes and materials such as ULE substrates that would be considered beneficial for EUV which requires more uniform and stable surfaces.

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Applicant's arguments with respect to claims 1-48 have been considered but are moot in view of the new ground(s) of rejection.

*Conclusion*

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized, sweeping flourish extending from the end of the name.

S. Rosasco  
Primary Examiner  
Art Unit 1756

S. Rosasco  
5/4/06